I have no relevant financial relationships to disclose or conflicts of interest to resolve.
YouTube Video

https://www.youtube.com/watch?v=I5Dsn4obCa4&feature=youtu.be
Learning Objectives

- Describe trends and terminology in maternal mortality reporting in United States
- Summarize leading causes of maternal mortality based on CDC Report from Nine Maternal Mortality Review Committees
- Understand value of state-level MMRCs and importance of multi-pronged approach (patient, provider, facility, systems, community)
Mortality Rates in the U.S.
Mortality Rates in the U.S.

Maternal Deaths in the U.S. Are on the Rise
Maternal mortality ratio (number of maternal deaths per 100,000 live births)

![Graph showing maternal mortality ratios](chart.png)

**Maternal Mortality Ratio**

<table>
<thead>
<tr>
<th>Region</th>
<th>1990</th>
<th>2013</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>380</td>
<td>210</td>
<td>-45%</td>
</tr>
<tr>
<td>Developed Regions</td>
<td>26</td>
<td>16</td>
<td>-38%</td>
</tr>
<tr>
<td>Developing Regions</td>
<td>430</td>
<td>230</td>
<td>-47%</td>
</tr>
<tr>
<td>United States</td>
<td>12</td>
<td>28</td>
<td>+136%</td>
</tr>
</tbody>
</table>

Source: World Health Organization
Maternal Mortality Crisis

DEADLY DELIVERIES

https://www.usatoday.com
Maternal Mortality Definitions

- Complex
- Ratio – not a rate
- Maternal mortality ratio
  - Maternal deaths/ live births
  - Numerator includes pregnancy losses and ectopics that may not be included in the denominator
- Not uniform
  - Which cases? How to capture them?
Death of a woman while pregnant or within 42 days of termination of pregnancy irrespective of the duration and the site of pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.
Pregnancy-Related Death

- Death of a woman during pregnancy or within one year of the end of pregnancy, from a pregnancy complication, a chain of events initiated by pregnancy or the aggravation of an unrelated condition by the physiologic effects of pregnancy.
Pregnancy-Associated Death

- Death of a woman while pregnant or within one year of termination of pregnancy, regardless of the cause
- Pregnancy-associated deaths make up the universe of maternal mortality
Ascertainment of Maternal Deaths

- Vital Statistics
  - National Center for Health Statistics
  - Pregnancy Mortality Surveillance System (PMSS)

- MMRCs
  - Increased ascertainment
  - Linking of birth and death certificates, death code related to pregnancy (‘O codes’), pregnancy checkbox on death certificate, hospital reporting, coroner reporting, media reporting
Issues with Ascertainment

- Reliance on vital statistics can result in missed cases
- Can also over-capture with death codes and pregnancy check-box
  - California still does not use the pregnancy check-box on the death certificate
  - Other states phased in this recommendation over years
Maternal Mortality
Trends - USA

- Due to different reporting among states no true MMR in the U.S. since 2007!
- Most of increase due to ascertainment
- MMR: 7.55 in 1993 to 21.5 in 2014
- Mainly due to two ICD-10 codes
  - Renal disease and “other maternal diseases classifiable elsewhere”
  - If these deaths excluded, no increase in MMR

Joseph et al Obstet Gynecol 2017;129:91
Maternal Mortality
Trends - USA

- Regression analysis to adjust for ascertainment
  - No increase in MMR (RR 1.09 (0.90-1.25))
- Checkbox states: MMR 22.4
- No checkbox states: MMR 9.9
- 90% of change in MMR due to ascertainment
- 28.8% due to misclassification

Joseph et al Obstet Gynecol 2017;129:91
Correction factors to adjust data for addition of the pregnancy check-box

26.6% increase in maternal mortality from 18.8 to 23.8 per 100,000 live births from 2000 to 2014

Excludes CA and TX

McDorman et al Obstet Gynecol 2016
National Maternal Mortality Ratios

It is an international embarrassment that the United States, since 2007, has not been able to provide a national maternal mortality rate to international data repositories such as those run by the Organization for Economic Cooperation and Development.21 This inability reflects the chronic underfunding over the past two decades of state and national vital statistics systems. Indeed, it was primar-

Progress Made!

- Development of infrastructure to fund and organize maternal death reporting
- Support for maternal mortality review committees in every state
- Standardization of reporting for aggregation at the national level
- Assessment of preventability with recommendations for action
Building U.S. Capacity to Review and Prevent Maternal Deaths

- Centers for Disease Control and Prevention
- CDC Foundation
- Association of Maternal-Child Health Programs (funded by Merck for Mothers)
Merck for Mothers funded established and new maternal mortality committees to improve infrastructure at state level

Ongoing interaction between CDC partners and state committees

- 42 states, 1 city, and 1 U.S. territory (92%)

Creation of MMRIA which is a standardized reporting tool for maternal death review
MMRIA

- MMRIA tool walks committee members through available documents for each case
- Make determination regarding:
  - Pregnancy related vs pregnancy associated
  - Preventability
- Recommendations moving forward
Report from Nine Committees

- Shared data from 9 states: Colorado, Delaware, Georgia, Hawaii, Illinois, North Carolina, Ohio, South Carolina, Utah
- Aggregated causes of deaths and assessment of preventability using a standardized data collection form
N=680 pregnancy-associated deaths
- 34.9% of deaths were pregnancy related
- 60% of cases thought to be preventable
  - Deaths from hemorrhage and cardiovascular disease were most likely to be classified as preventable
- Includes opportunities to alter outcome at both the clinical and non-clinical, and public health systems levels
Contribution Factors

- Patient, family, healthcare provider, facility, systems or community level

Most cases multifactorial

- On average at least 4 factors identified
- “Swiss cheese model”

Need involvement from multi-disciplinary stakeholders moving forward
Aggregated Causes of Death

From Report from Nine Maternal Mortality Review Committees
Causes of death varied by race and ethnicity

- Top 5 causes non-Hispanic white women were cardiovascular, hemorrhage, infection, mental health conditions, cardiomyopathy
- Top 5 causes non-Hispanic black women were cardiomyopathy, cardiovascular, preeclampsia and eclampsia, hemorrhage, embolism
Maternal Mortality
Racial Disparity

- Persistent
- Reasons not clear
- U.S. data sets 2013 – 2014 (27 states)
  - Over 2.5 fold increase in MMR for Non-Hispanic black women
- Similar data in U.K.
  - Black women RR 4.19 (2.69-6.35)

MacDorman et al; Obstet Gynecol 2017;129:811-8
Knight et al; Confidential Enquiries 2016
Maternal Mortality
Racial Disparity

- Reasons complex
- Not only due to poverty and reduced access to medical care
- Status syndrome – chronic stress
- Co-morbidities, obesity, poor care, miscommunication with health care providers, life-style issues, etc.
- Higher case fatality rate, unconscious bias
- Cardiomyopathy, VTE, preeclampsia
Causes of Death

- Only two states had the same three leading causes of maternal deaths
- Demonstrates importance of maternal mortality data at the state level
Colorado Data

Maternal deaths in Colorado from 2004 to 2012 (N=211)

- Suicide or accidental overdose: n=63
- Motor vehicle crash: n=36
- Non-cardiovascular conditions: n=35
- Cardiovascular conditions: n=22
- Embolism: n=19
- Homicide: n=15
- Infection: n=10
- Hemorrhage: n=7
- Undetermined: n=2
- Other trauma: n=2

Percentage of all maternal deaths

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Classifications are mutually exclusive

Utah Data

- Three most common causes
  - Drug-induced 26%
  - VTE 13%
  - MVC 12%
- Most commonly opioids

Smid et al Obstet Gynecol 2019
22 yo G1P1 at 2 months postpartum, found unresponsive by police after her mother called 911 when she did not answer phone.

Administration of multiple doses of naloxone was ineffective, she never regained pulse or respirations.

Time of death unknown, probably > 4 hours.

Cause of death: Unintentional/Acute Fentanyl Intoxication.
Began prenatal care at 20 weeks

Unaware she was pregnant until boyfriend told her she looked “knocked up”

Patient disclosed injection drug use

Referred to methadone maintenance program

History of childhood trauma

Suspicion of intimate partner violence from the father of the baby
Scored 18 on PHQ-9 consistent with severe depression
  - Antidepressant prescribed
  - Continued antidepressant throughout her pregnancy

Missed several prenatal appointments, which she stated was due to transportation issues
Fictitious Case (the details)

- Admitted for observation at 34 weeks gestation with vaginal bleeding
  - Concern for intimate partner violence
- Delivered viable female infant at 36 weeks gestation
  - Infant had mild NAS symptoms but did well without pharmacotherapy
- Antidepressant Rx refilled on discharge
Missed scheduled postpartum visits at 2 and 6 weeks
Per practice policy, a “no show” letter was sent to her last known address
No further attempts to follow up
At 6 weeks she lost Medicaid coverage
Dropped out of methadone treatment due to cost
MMRCs have a unique ability to make recommendations to prevent deaths due to mental health conditions and substance use disorder

- Assess your MMRC membership to assure that you have the relevant expertise needed to review substance use cases
  - Perinatal psychiatrist
  - Prenatal care provider specializing in serving women with substance use disorder
  - Opioid grantees
  - Community providers of support services or MAT
Case Review

- Details are important in maternal health case review
- Was substance use and other mental health disorders disclosed?
- Was a treatment plan initiated?
- Was the treatment plan followed?
- Were there barriers to accessing resources?
What were the results of her autopsy? Any special ME notes? What can we find in PDMP, VDRS, first responder notes?

Did any of the ER visit, PNC or hospitalization records show that she was she screened for substance use?

Was she referred to a mental health provider?

What stressors were present before, during and after pregnancy?

Was there any record of drug charges filed against her?

Did she have stable housing? Was there a DV screen?
Data Sources

- Prenatal records, hospital records, autopsy
- PDMP
- Child welfare data
- Police, sheriff, and court records
- Other mortality review systems
  - Violent death reporting system (VDRS)
  - Local overdose fatality reviews
  - Fetal and infant mortality reviews (FIMR) and child death reviews (CDR)
Data Sources

- Systems such as VDRS, local overdose fatality reviews, FIMR, and CDR might already be reviewing the same or related cases

- Value:
  - Can save time gathering records, take advantage of existing (local) partnerships, and minimize duplicate records requests from multiple systems

- Challenges:
  - Requires coordination of variable processes
  - Timelines for case review may be very different
Circling Back: Our Fictitious Case

- Poor coordination between obstetric and MAT providers
- Inaction when patient presented with 3rd trimester bleeding
  - No screening for suspicion of IPV
- D/C without psychiatric or primary care transition
- Loss to postpartum follow-up
- Loss of medical insurance
Was the death preventable?

### COMMITTEE DETERMINATION OF PREVENTABILITY

A death is considered preventable if the committee determines that there was at least some chance of the death being averted by one or more reasonable changes to patient, family, provider, facility, system and/or community factors.

<table>
<thead>
<tr>
<th>WAS THIS DEATH PREVENTABLE?</th>
<th>YES</th>
<th>NO</th>
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<tbody>
<tr>
<td>CHANGE TO ALTER OUTCOME?</td>
<td>GOOD CHANCE</td>
<td>SOME CHANCE</td>
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</table>

### CONTRIBUTING FACTORS WORKSHEET

What were the factors that contributed to this death? Multiple contributing factors may be present at each level.

<table>
<thead>
<tr>
<th>CONTRIBUTING FACTOR LEVEL</th>
<th>CONTRIBUTING FACTOR (SEE BELOW) AND DESCRIPTION OF ISSUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PATIENT/FAMILY</td>
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<tr>
<td>PROVIDER</td>
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<td>FACILITY</td>
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<td>SYSTEM</td>
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</tr>
<tr>
<td>COMMUNITY</td>
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### RECOMMENDATIONS OF THE COMMITTEE

If there was at least some chance that the death could have been averted, what were the specific and feasible actions that, if implemented or altered, might have changed the course of events? [Who?] should [do what?] [when?]

<table>
<thead>
<tr>
<th>RECOMMENDATIONS OF THE COMMITTEE</th>
<th>LEVEL OF PREVENTION (SEE BELOW)</th>
<th>LEVEL OF IMPACT (SEE BELOW)</th>
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</table>
Was the death preventable?

- Depression and intimate partner violence strongly associated with opioid use disorders in women
- Prenatal depression highly predictive of postpartum depression
Postpartum women increased risk for OD:
- Physiologic changes of pregnancy resolve, decreasing volume of distribution and rate of drug metabolism
- Abstinence from illicit use of opioids during pregnancy decreases tolerance
- Untreated mental illness is a known trigger for relapse
- Loss of insurance → cessation of treatment
### RECOMMENDATIONS OF THE COMMITTEE

If there was at least some chance that the death could have been averted, what were the specific and feasible actions that, if implemented or altered, might have changed the course of events? [Who?] should [do what?] [when?]

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</tbody>
</table>
MMRCs involve multiple disciplines and use the various viewpoints to make recommendations for action to prevent future deaths.

- **Public Health**: Should promote peer recovery support model.
- **Stakeholders**: Should advocate for increased access to tx programs for women with SUD in pregnancy and postpartum.
- **Facilities**: Should educate providers on screening for SUD, depression, and IPV.
- **PQC**: Should promote obstetric and MAT provider coordination and patient contact when appointments are missed.
- **Community Advocates**: Should target naloxone distribution to patients with OUD and their families.
- **Payers**: Should reimburse for outpatient case mgmt. prenatally and postpartum.
- **Stakeholders**: Should advocate for postpartum coverage that extends to a minimum of 1 year.
Redefining postpartum care

- Redefine goals of maternity care: from achieving a favorable pregnancy outcome to supporting the transition to parenting
  - Multidisciplinary, team based, integrated/co-located
Was the death pregnancy-related?

**MATERNAL MORTALITY REVIEW COMMITTEE DECISIONS FORM v17**

<table>
<thead>
<tr>
<th>REVIEW DATE</th>
<th>RECORD ID #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month</td>
<td>Day</td>
</tr>
</tbody>
</table>

**PREGNANCY-RELATEDNESS: SELECT ONE**

- PREGNANCY-RELATED
  - The death of a woman during pregnancy or within one year of the end of pregnancy from a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the physiologic effects of pregnancy.
- PREGNANCY-ASSOCIATED, BUT NOT -RELATED
  - The death of a woman during pregnancy or within one year of the end of pregnancy from a cause that is not related to pregnancy.
- PREGNANCY-ASSOCIATED BUT UNABLE TO DETERMINE PREGNANCY-RELATEDNESS
  - (i.e. false positive, woman was not pregnant within one year of her death)

**COMMITTEE DETERMINATION OF CAUSE(S) OF DEATH**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>CAUSE (DESCRIPTIVE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMMEDIATE</td>
<td></td>
</tr>
<tr>
<td>CONTRIBUTING</td>
<td></td>
</tr>
<tr>
<td>UNDERLYING</td>
<td></td>
</tr>
<tr>
<td>OTHER SIGNIFICANT</td>
<td></td>
</tr>
</tbody>
</table>

**IF PREGNANCY-RELATED, COMMITTEE DETERMINATION OF UNDERLYING CAUSE OF DEATH**

Refer to page 3 for PMS-AMD cause of death list. If more than one is selected, list in order of importance beginning with the most compelling (1-3; no more than 2 may be selected in the system).

<table>
<thead>
<tr>
<th>DID OBESITY CONTRIBUTE TO THE DEATH?</th>
<th>YES</th>
<th>PROBABLY</th>
<th>NO</th>
<th>UNKNOWN</th>
</tr>
</thead>
<tbody>
<tr>
<td>DID MENTAL HEALTH CONDITIONS CONTRIBUTE TO THE DEATH?</td>
<td>YES</td>
<td>PROBABLY</td>
<td>NO</td>
<td>UNKNOWN</td>
</tr>
<tr>
<td>DID SUBSTANCE USE DISORDER CONTRIBUTE TO THE DEATH?</td>
<td>YES</td>
<td>PROBABLY</td>
<td>NO</td>
<td>UNKNOWN</td>
</tr>
</tbody>
</table>

**DID THIS DEATH A SUICIDE?**

- YES
- PROBABLY
- NO
- UNKNOWN

**DID THIS DEATH A HOMICIDE?**

- YES
- PROBABLY
- NO
- UNKNOWN

**IF HOMICIDE, SUICIDE, OR ACCIDENTAL DEATH, LIST THE MEANS OF FATAL INJURY**

- FIREARM
- SHARP INSTRUMENT
- BLUNT INSTRUMENT
- POISONING/ OVERDOSE
- HANGING/ STRANGULATION/ SUPOCATION
- FALL
- PUNCHING/ KICKING/BEATING
- EXPLOSIVE
- DROWNING
- FIRE OR BURNS
- MOTOR VEHICLE
- INTENTIONAL NEGLECT
- OTHER, SPECIFY:
- UNKNOWN
- NOT APPLICABLE

**IF HOMICIDE, WHAT WAS THE RELATIONSHIP OF THE PERPETRATOR TO THE DECEASED?**

- NO RELATIONSHIP
- PARTNER
- EX-PARTNER
- OTHER RELATIVE
- OTHER, ACQUAINTANCE
- OTHER, SPECIFY:
- UNKNOWN
- NOT APPLICABLE

**DID THE COMMITTEE AGREE WITH THE UNDERLYING CAUSE OF DEATH LISTED ON DEATH CERTIFICATE?**

- YES
- NO
Pregnancy-Related

- The death of a woman during pregnancy or within one year of the end of pregnancy from a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the physiologic effects of pregnancy.
If she had not been pregnant, would she have died?

Mental health, intimate partner violence, stress, drug metabolism closely linked with pregnancy.
Circling Back: Our Fictitious Case

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>Probably</th>
<th>No</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did obesity contribute to the death?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did mental health conditions contribute to the death?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did substance use disorder contribute to the death?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was this death a suicide?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was this death a homicide?</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

If homicide, suicide, or accidental death, list the means of fatal injury:
- Firearm
- Sharp instrument
- Blunt instrument
- Poisoning/overdose
- Hanging/strangulation/suffocation
- Fall
- Punching/kicking/beating
- Explosive
- Drowning
- Fire or burns
- Motor vehicle
- Intentional neglect
- Other, specify: [ ]
- Unknown
- Not applicable

If homicide, what was the relationship of the perpetrator to the decedent?
- No relationship
- Partner
- Ex-partner
- Other relative
- Other acquaintance
- Other, specify:
- Unknown
- Not applicable
Next Steps!

- Expansion of data collection using MMRIA to aggregate as national data
- Translation of state level recommendations into action
- Eliminate preventable maternal deaths
Maternal Mortality
National Partnership Maternal Safety

- Priority bundles:
  - Hemorrhage
  - Hypertension
  - VTE

- Unit improvement bundles:
  - Recognition of early warning signs
  - Internal case reviews
  - Support tools for families / staff

D’Alton et al; Obstet Gynecol 2014;123:973-7
Maternal Mental Health Perinatal Depression and Anxiety Patient Safety

Log in to access this valuable resource. Registration is required to use this and other patient safety resources.

LOG IN TO DOWNLOAD BUNDLE >>

The National Improvement Challenge
The National Improvement Challenge is an innovative program that seeks to improve maternal care.

Participate in Action Series
The Council on Patient Safety in Women’s Health Care is pleased to sponsor and promote this important initiative.
Levels of Maternal Care

- Partnership ACOG, SMFM and CDC
CDC implemented Levels of Care Assessment Tool (LOCATe) to help determine maternal levels of care.

Goal to get women to deliver in an appropriate birth setting based on individual needs and level of risk.

Maternal LOC verification program piloted in GA, IL and WY.

Zahn et al Obstet Gynecol 2018
Hidden Context of Prenatal Visit

**ENVIRONMENTAL BARRIERS**
- Legal Problems
- Unemployment
- Housing Instability
- Transportation
- Food Insecurity
- Child protective services

**PROFESSIONALS**
- Obstetric providers
- Pediatric Providers
- Addiction treatment providers

**SYMPTOMS**
- Pregnancy & Postpartum
- Trauma History
- Physiology of addiction
- Psychiatric Comorbidities

**Social Environment**
- Family Dynamics

**Hidden Context of Prenatal Visit**

**Pregnancy & Postpartum**

**Social Environment**

**Family Dynamics**
Death
Near miss
Severe maternal morbidity
Maternal morbidity requiring hospitalization
Maternal morbidity requiring emergency department visit
Maternal morbidity requiring primary care or specialist visit

Long-Term Outcomes
Elimination of preventable maternal deaths
Reductions in maternal morbidity
Population-level improvements in the health of reproductive aged women
Thank you!

- CDC Staff
  - Dave Goodman, Julie Zaharatos, Nicole Davis, Amy St Pierre
- AMCHP and Merck for Mothers
- Colorado MMRC
- Utah PMRC
- Camille Hoffman, Elliott Main, William Callaghan, Robert Silver
“Let us celebrate our successes while remaining clear about our direction moving forward.”